The Advance(s) of Cardiac Surgery and Anaesthesia

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The introduction of anaesthesia in 1846 opened up completely new fields of endeavour for the surgeons of that day and for their successors. No longer did surgery have to equate with a "smash and grab" approach where speed was of the essence. For the first time it was possible to operate in a considered and deliberate manner with the prospect of more elaborate and reparative procedures becoming a reality.

As surgery became safer with antisepsis, intra-abdominal surgery became possible but operations inside the thorax remained a closed book. The ability to deal with the problems inherent in the creation of the necessary pneumothorax was still a long way off. Despite many attempts, regular intra-thoracic procedures had to await the recognition of the need for and eventually the advent of some form of assisted respiration or intermittent positive pressure ventilation. It was the introduction of muscle relaxants in 1942 which revolutionised how this could be accomplished.

Once the principles were understood, there were several exciting developments. In 1939 a patent ductus arteriosus was ligated, a repair of coarctation of the aorta was carried out in 1945, the Blalock Taussig shunt for palliative treatment of cyanotic congenital heart disease was introduced the same year and mitral valvotomy was successfully carried out before the end of the decade. The first ligation of a patient ductus was done in Northern Ireland by Barney Purce at the Royal Victoria Hospital in 1948, and the first mitral valvotomy was carried out by Tom Smiley also at the Royal in 1950.

All these procedures required minimal interruption of the circulation but they were nevertheless enormous advances. At that time monitoring, if used, was primitive, diathermy unavailable and pacemakers and the defibrillator were still to be invented.

This however was a beginning and as confidence increased, surgeons began to be even more adventurous. There were startling developments in anaesthesia with the introduction of less depressant and less explosive anaesthetic agents and with the gradual introduction of basic monitoring, anaesthesia was ready for the next step forward. Anything but the simplest procedures required the ability to stop the circulation for longer than 1-2 minutes. The advent of the use of moderate hypothermia to 30-32 degrees C allowed periods of circulatory arrest to be prolonged; 5-8 minutes became possible. Success depended on accurate diagnosis. This was not always possible and the risks were considerable.

There was an ever increasing demand for some form of cardiopulmonary bypass to allow time for more prolonged open heart surgery. The 1950s saw the successful culmination of many efforts and technical advances and in 1953 Gibbon and his co-workers in Philadelphia reported the first successful use of a heart lung machine to facilitate the closure of a secundum ASD in a teenage girl who has been a long term survivor. At that they reported the use of the same machine in several other cases but with no survivors. Even so, 1953 showed what was possible.

For an improvement in quality, there needed to be better diagnosis, anaesthesia, surgery, perfusion and intensive care. The rest of the 1950s saw many disasters and other methods such as cross circulation and profound hypothermia were tried but successful cardiopulmonary bypass also became more common. The defibrillator and the pacemaker arrived, monitoring improved steadily, anaesthetic agents appeared which were more suitable for the poor cardiovascular system and, with experience, better overall management was possible.

The first open heart case in the United Kingdom was done in 1958 at the Hammersmith Hospital by Bill Cleland, with the anaesthetist John Beard. Developments were swift and Birmingham reported their experience in 20 cases in 1960. By contrast and at that same time Cooley reported his experience of 450 cases in Houston, Texas.

The 1960s saw the emergence of an interesting time in the development of open heart surgery. Houston was in the forefront of demonstrating how to do large volume work and this was still their forte when I

worked there in 1967/68. At that time Denton Cooley was operating on 8 cases per day in two theatres; later expanded to 25-30 cases per day. At the same time Dwight McGoon in the Mayo Clinic was demonstrating high quality by doing a series of 100 aortic valve replacements with zero mortality. In the United Kingdom Donald Ross and Bill Cleland were establishing cardiac surgery on a firm footing.

New units for open heart surgery were starting in many places in the United Kingdom and the first such operation in Belfast was performed in the spring of 1960 by Tom Smiley, with Maurice Brown as the anaesthetist.

Most centres struggled with problems of apparatus, diagnosis, inadequate experience and lack of any real intensive care. It is fascinating that in Houston the cardiac surgeons came from a vascular surgery training in contrast to this country where the background was thoracic surgery. This probably made the introduction of coronary artery bypass surgery easier in the United States. Whatever these considerations, it became clear that Northern Ireland needed an enlargement of the available skills, a dedicated unit, dedicated personnel and an intensive care unit.

In the late 1960s the Royal and the Northern Ireland Hospital's Authority decided that this was the way forward and a new unit was established in 1968 with Pat Molloy as surgeon, Morrell Lyons as full time anaesthetist with Richard Clarke keeping everyone on the right lines. Pat Molloy had been a consultant in Broad Green, Liverpool, and Frank Pantridge had a lot to do with his enticement here.

The unit started in June 1968 and, in the last 6 months of 1968, a total of 80 operations were done, mostly open with an overall mortality of 12%, which was well within the standards of the day. In 1969 the working pattern for the next few years was established at 5 operations per week, though with a mortality rate of 17%. The work gradually increased as the team expanded with the arrival of Jack Cleland and Jim Morrison. Pat Molloy left for New Zealand in 1973 and was replaced by Hugh O'Kane who then established coronary artery bypass surgery in the province.

The work increased in fits and starts, dictated by finance and personnel rather than need until its present level of 1150 cases per annum. Today's mortality is in sharp contrast to that of 1969 with an overall mortality rate of 2.8%,

This marked improvement has been due to many changes.

1. Surgery and cardiology have vastly improved. Techniques arc better and there are better sutures, better diagnoses, better assistants, better valves, better hardware.

2. Anaesthesia has also improved. After some early disasters it was very evident that adequate preoperative assessment was essential. There are now superior techniques and the introduction of high dose narcotic anaesthesia helped markedly in the decreased myocardial oxygen demands. There has been a revolution in monitoring and much better interpretation of the data. Pulse oximetry was a quantum leap forward and the more intelligent use of inotropes allied to better managed perfusion have played their part. The high quality technical assistance makes this all function smoothly.

3. Perfusion has changed markedly. There are now more efficient and smaller oxygenators and tubing which is less damaging to the blood. The better techniques and the use of arterial filters have helped in the decrease in air emboli and in consequent cerebral damage. The management of perfusion is dependent on highly trained perfusionists and their contribution is vital.

4. Myocardial preservation has been revolutionised by the use of cardioplegia.

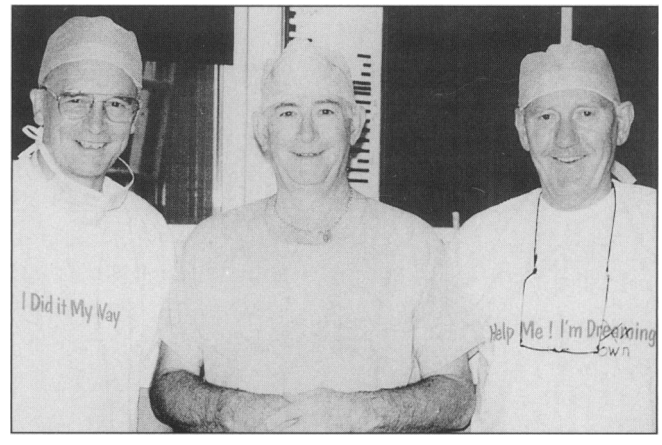

Figure 1 Dr. S Morrell Lyons (Anaesthetist), Mr J Cleland (Surgeon) and Mr E. Stewart (Perfusionist) - doing it their way

5. Intensive care nursing, good physiotherapy, data interpretation and inotropes and the balloon pump have all made major contributions to the improving scene.

6. The applied results of anaesthesia and surgical research have also played their part.

THE FUTURE.

It is always fun to speculate about the future without the responsibility for the outcome.

Valve Surgery

30 years ago it was believed that by the end of this century the need for valve surgery would be minimal. Rheumatic fever was already rare and so a further 30 years would see the disappearance of rheumatic heart disease. However the demand for valve surgery is very little different today than in 1968. Aortic stenosis in the older age groups and mitral valve repair operations secondary to disruption of the valve have come more to the fore so in the next thirty years valve surgery will be very much part of the workload

By that time there will be prostheses available, with a valve more with the characteristics of our own original valves, with better flow pattern, causing no cellular damage and doing away with the need for anticoagulants. With this available then valve replacements will be done before any myocardial or pulmonary damage has occurred and so better results will be obtained.

Coronary Artery Grafts

Will the present preventative measures eliminate the need for coronary artery bypass grafting (CABG) in the next generation? So far I see no signs. Looking at my fellow man, overweight, increasingly sedentary, still smoking, working at pressure, reluctant to take antihypertensive therapy and with no power to select their parents I do not see the need for CABG changing just yet. What will the operation be? Will there be artificial graft material instead of the internal mammary artery and saphenous vein grafts? Or indeed will the operation of choice be a total heart replacement with an allograft? Will we have changed to minimal access surgery or will the operations be by telemedicine?

Congenital Heart Disease

Congenital heart disease may change with social change. The falling birth-rate and abortion are great changes. But will genetic engineering bring change? Will intrauterine treatment have anything to offer? Or again will the allograft be the answer to the most complex problems.

Perfusion

Perfusion apparatus has become smaller and smaller and more and more efficient. Will it become implantable with an arterial assist device or artificial heart in the circulation be the answer?

Anaesthesia

In thirty years anaesthesia will be non pharmaceutical, maybe electrical. Total pain relief without side effects will be available and operative episodes will pass without memory for unpleasantness.

Intensive Care

In intensive care the monitoring will demonstrate full data from non invasive techniques. The management loop will be closed so that the staff will be able to devote more time to the patients themselves. Myocardial preservation will eliminate the need for most inotropes and the better myocardium will decrease the stay needed in the intensive care.

Will these forecasts come true? Who will be around to see? At any rate I wish them good luck.